

Nature-Based Solutions for adapting to climate change: practical actions of the Guadeloupe Port Authority.

Soluciones Basadas en la Naturaleza para adaptarse al cambio climático : acciones concretas de la Autoridad Portuaria de Guadeloupe.

Des Solutions Fondées sur la Nature pour l'adaptation au changement climatique : des actions concrètes de Guadeloupe Port Caraïbes .

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EXTENDED ABSTRACT

INTRODUCTION

Guadeloupe is a French outermost region in the Caribbean, is the largest island in the Lesser Antilles with a land area of 1,705 km². The archipelago is made up of two main islands and several smaller ones, a reef-lagoon (865 km²), 200 km of linear reefs, and 102 km² of seagrass meadows (Ifreco 2021). These ecosystems are subject to numerous anthropogenic pressures in addition to those related to climate change, such as eutrophication of coastal waters, increased turbidity and hypersedimentation due to terrestrial erosion, and chemical pollution of water from agricultural and sewage sources. However, ecosystems health is key to limiting the physical impact of hurricane-generated swells, ensuring carbon storage for climate regulation and buffering ocean acidification.

The LIFE Adapt'Island project led by the Guadeloupe Port Authority (GPA), is a five-year project. This project aims to set up pilot operations of Nature-Based Solutions (NBS) to restore coral reefs and seagrass meadows in the Guadeloupe archipelago. NBS are defined by IUCN as "actions aimed at protecting, sustainably managing and restoring natural or modified ecosystems to directly address societal challenges in an efficient and adaptive manner, while ensuring human well-being and producing benefits for biodiversity". NBS involve three types of actions, which may be combined at regional and local level: (1) Preserving the integrity and good ecological status of ecosystems; (2) Improving sustainable management of ecosystems used by human activities; (3) Restoring degraded ecosystems or creating ecosystems (IUCN 2016).

The solutions implemented by the GPA for coral reefs focus on two reef-building species classified as critically endangered by the IUCN: *Acropora cervicornis* and *Acropora palmata*. To this end, GPA manages two coral farms in the natural environment where these two species are bred, and the cuttings produced are transplanted onto degraded reefs. Coral gametes are also collected during massive spawning episodes to diversify the genetic pool of farm colonies. Regarding to seagrass meadows, operations focus on the heritage species *Thalassia testudinum*, which plays a major role in the ecological functioning and ecosystem services of this ecosystem. The operations implemented are mainly to protect seagrass meadow areas from uprooted by boat anchors. The second objective is to raise public awareness on this essential but unrecognized ecosystem. To finish the third goal is to acquire knowledge and enhance local players skills about *Thalassia testudinum* cultivation.

METHODS

As part of the LIFE Adapt'Island project, several levers are used to achieve the objectives of protecting essential ecosystems to adapting our territory to the impacts of climate change. As defined by the IUCN, firstly, NBS are applied to preserve the integrity of ecosystems and their good ecological status. This approach is implemented through the creation of eco-moorings in an area heavily used for pleasure boat mooring. The implementation of eco-moorings has been precisely defined based on boater usage and the areas most impacted, according to aerial drone observations. Two types of concrete eco-moorings were designed to create micro-habitats. Monitoring protocols have been defined to characterize the short- and medium-term impacts of the presence of these eco-moorings on adjacent seagrass meadows for five years.

The second set of NBS implemented in the project concerns the improvement of sustainable management of these ecosystems by creating protocols adapted to our local conditions (species, environment, regulations, pollution, etc.). For seagrass meadows and to raise public awareness of this essential but unrecognized ecosystem, we are creating an underwater trail on seagrass meadows near a nesting site for hawksbill turtles. The operational phase of LIFE Adapt'Island, such as the construction of structures or the execution of protocols, is carried out by Guadeloupean players and companies, to guarantee the acquisition of knowledge and the enhancement of skills by local professionals.

The third category of NBS concerns degraded ecosystems restoration. The actions carried out on coral reefs are the production of *Acropora cervicornis* and *Acropora palmata* cuttings on farms located in natural environments. These are

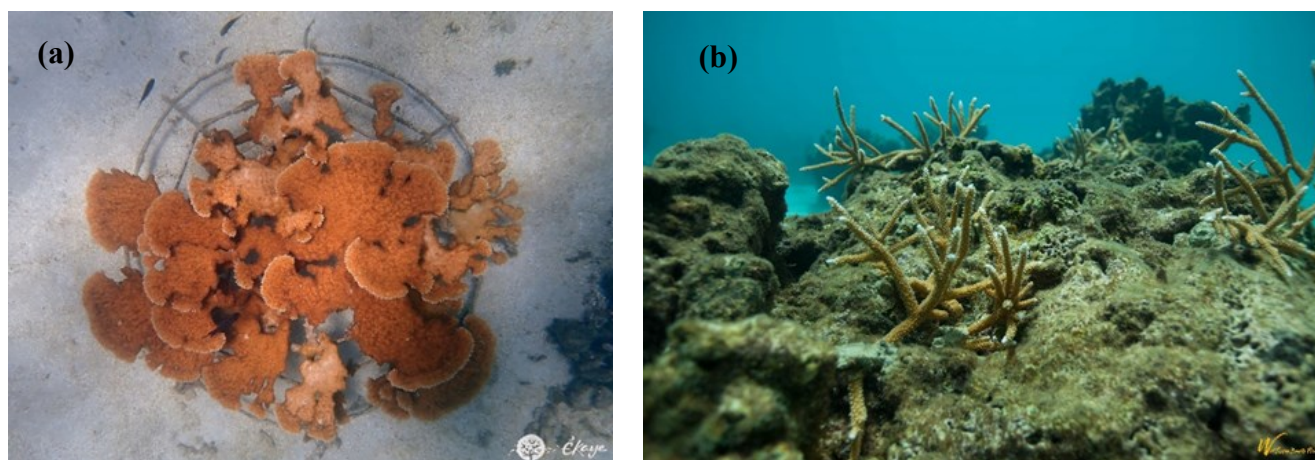


Figure 1. (a) Dome with *Acropora palmata* "mother" colonies on the farm, (b) *Acropora cervicornis* cuttings transplanted onto a degraded reef.

then transplanted each year onto degraded reefs. This will be followed by a five-year monitoring program to assess the survival of the transplants and the evolution of the site's fauna and macro-algae (fish, diadem urchins, coral diseases). Coral gametes of *A. palmata* are also collected during massive spawning episodes to optimize recruitment of this species while diversifying the genetic pool of farm colonies. For the seagrass meadows, *Thalassia testudinum* fruits are collected from the natural environment to test their germination and growth in a controlled environment. The seedlings produced will be transplanted to the seagrass meadows where they have been uprooted by anchors.

Throughout all these actions, awareness-raising activities are carried out through: (1) meetings with local politicians and natural area managers to present the operations planned on their communal territories; (2) the organization of an annual local scientific council to feedback and validate the protocols drawn up for the coral reefs operations; (3) a TV and press campaign on the project aimed at local citizens; (4) awareness-raising actions aimed at port stakeholders and schoolchildren; (5) the organization of an international symposium bringing together these various players and the international experts who make up the LIFE project's scientific committee.

RESULTS AND CONCLUSION

Most of the project's operations are still underway, and most of the feedback concerns coral reef restoration. Continuous management of the two coral farms enables to produce an average of 500 fragments of *Acropora cervicornis* and 100 fragments of *Acropora palmata* per year since 2020 (Fig. 1a). This enables to transplant an average of 400 fragments per year (Fig. 1b). The protocols used are update each year (cleaning of structures, disease management, transplantation) based on feedback from the previous year's operations and any difficulties encountered. These pilot operations are intended to be replicated, so that all protocols can be used for similar actions on other Caribbean islands.

KEYWORDS: Coral farm, seagrass meadow, *Acropora cervicornis*, *Acropora palmata*, *Thalassia testudinum* .

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